Status of the Vermilion Snapper (*Rhomboplites aurorubens*), Red Snapper (*Lutjanus campechanus*), and Gag (*Mycteroperca microlepis*) in the U.S. Gulf of Mexico

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ABSTRACT

This is a summary of the most recent stock assessments of three important reef fish in the U.S. waters of the Gulf of Mexico, vermilion snapper (*Rhomboplites aurorubens*), red snapper (*Lutjanus campechanus*), and gag (*Mycteroperca microlepis*). For commercial vessels reporting using handlines to harvest vermilion snapper, 50 percent of the catch is accounted for by approximately 30 vessels (3% of the fleet). Of the recreational headboats reporting harvesting vermilin snapper, 10 vessels account for approximately 50% of the total vermilion snapper headboat harvest. There is evidence to suggest that the recent decrease in commercial landings of vermilion snapper may be due in part to similar trends in recruitment patterns. Red snapper remain highly overfished with a large proportion of the fishing mortality being applied during the juvenile stages in the form of bycatch from the shrimp fishery. Regulations that required the use of Bycatch Reduction Devices (BRD) were put into effect in 1998. Examination of catch rates of juvenile red snapper reveal the possibility of annual and inter-annual variability in juvenile settlement. Based on observations of annual gag harvest, there is neither an obvious increasing nor decreasing trend in landings. Gag compose approximately 33 percent of the commercial landings of grouper species and approximately 15 percent of total commercial reeffish landings. The bulk of the 1986-1996 commercial catch of gag was from the eastern Gulf of Mexico to the west and north of Tampa - St. Petersburg, Florida. An increase in the estimated number of recreational fish discarded dead has been observed starting in 1991. It is possible that these increases in 1994, 1995, and 1996 were due to the strong 1993 year class recruiting into the fishable population, but not yet large enough to be fully recruited past the 20 inch minimum size.

KEY WORDS: Vermillion snapper, red snapper, gag grouper, stock assessment

INTRODUCTION

Data Sources

Landings statistics for commercially harvested fish were available from 1962 to 1996 (computer files maintained by the Fishery Dependent Data Group (FDDG), Research Management Division, Southeast Fisheries Science Center (SEFC), Miami). The U.S. portion of the landings used in this assessment were separated from foreign catches by a location code in the data file. Groupers were not separated to species prior to about 1986 but were included in a category termed "unclassified grouper."

Also available was data from the Gulf of Mexico Reeffish Logbook Program. This program was phased in 1989 and was in full operation in 1990. From 1989 to 1992 all participants in all states (Florida, Alabama, Mississippi, Louisiana, and Texas) except Florida were required to report on a per-trip basis; 20% of the Florida fishers were required to report and 100% of Florida trap fishers. In 1993, a phasing in of 100% reporting for Florida fishers was started.

The recreational harvest estimates were derived from a combination of two sources. The primary data source was the Marine Recreational Fisheries Survey (MRFSS), which covers the period 1981-1996. This survey provides estimates of the numbers of fish harvested during bimonthly periods (waves) by state and mode (shorebound, private/rental boats and party/charterboats), with several exceptions. The suspension of the party boat sampling by the MRFSS coincided with an expansion of the NMFS headboat survey conducted by the NMFS Beaufort Laboratory (data courtesy R. Dixon, SEFC Beaufort Laboratory) to include U.S. Gulf of Mexico ports. These latter data provide estimates of landings by partyboats for all states after 1985 and constitute the second source of recreational harvest estimates.

The third source of recreational harvest estimates was provided by the Texas Parks and Wildlife Department (TPWD) coastal sport fishing survey (data courtesy Texas Parks and Wildlife). This survey provides estimates for numbers of fish harvested by boat modes exclusive of party boats for Texas for 1986-1989. Harvest by shorebound fishermen has not been included in the estimates since 1985.

The NMFS Pascagoula, MS, Laboratory has conducted a bottom trawl survey in the northern Gulf of Mexico in the fall of each year since 1972. This program has become known as the "Fall Groundfish Survey" and is described in some detail by Nichols and Pellegrin (1992). This survey is conducted primarily with 40-foot bottom trawls in October and November. For each set, the number of fish caught, their total weight and trawl duration are known. This information provides an index of numerical abundance (i.e. , the number captured per tow-hour).

The SEAMAP program has been coordinating trawl samples in the Gulf of

Mexico during June and July since 1982. The data are maintained at the NMFS Pascagoula, MS, Laboratory and were provided by Pascagoula Laboratory staff for the analyses in this report. These samples are taken with the same gear used in the NMFS Fall Groundfish Survey, but even when restricted to the 5 to 50 fathom depth interval, they cover a much larger area. Summaries of the Summer SEAMAP

VERMILION SNAPPER

Commercial Landings

The great majority of vermilion snapper are landed with power and handlines (Figure 1). Some landings come from bottom longlines, however, this fraction has decreased since 1991. Traps are also used in the state in Florida, but make up a very small percentage of the total landings.

Landings of vermilion snapper could have been considered insignificant from 1963 to the mid 1970's. Landings increased almost every year until 1993 when they peaked at approximately 2,725,000 pounds. The 1996 landings, however, were down approximately 312k pounds (14%) from the previous year, and approximately 866,000 pounds (-32%) from their high in 1993.

In 1996 a total of 395 vessels reported landing vermilion snapper with handline gear; 50 percent of the landings were accounted for by the first 23 vessels (5.8%), 75 percent by the first 50 vessels (12.7%), and 95 percent by the first 122 vessels (30.9%). In 1996 a total of 64 vessels reported landing vermilion snapper with bottom longline gear; 50 percent of the landings were accounted for by the first 4 vessels (6.3%), 75 percent by the first 9 vessels (14.0%), and 95 percent by the first 24 vessels (37.5%).

Recreational Landings

The 1996 recreational landings were down approximately 600,000 pounds (-50%) from the previous year (Figure 2). Estimates of charter boat landings were down by approximately 378,000 fish (-62%) from the previous year. Estimates of headboat landings were down approximately 140k fish (32%) from the previous year. Ten headboats account for approximately 50% of the total vermilion snapper harvest from this mode. The mean number of vermilion snapper harvested per trip by these ten headboats has dropped from a peak of 291 fish/trip in 1992, to 223 fish/trip in 1993, to 188 fish/trip in 1994, to 180 fish/trip in 1995, and to a record low of 134 fish/trip in 1996.

Trends in Recruitment

Presence/absence sampling has been used successfully to characterize recruitment strength in adult stocks (Mangel and Smith 1990; Uphoff 1993). The proportion of positive tows (PPT, percent of tows where vermilion snapper

were present) from the Fall Groundfish Survey were examined for their usefulness as an index of recruitment. These data reflect mostly the abundance of age 0 and age 1 vermilion snapper. Examination of both the CPUE and PPT trends indicate that the CPUE is much more erratic with an obvious outlier in 1990. The PPT trend on the other hand shows a smoother trend with less dramatic year-to-year variability. Furthermore, the PPT trend shows an obvious similarity to the trend in the commercial landings.

I used multiple regression to test the hypothesis that there was no significant relationship between the PPT time series and the time series of commercial landings of vermilion snapper. The dependent variable in this analysis was the reported landings. Four independent variables initially were included in the analysis: the juvenile index (PPT trend) of the proceeding year was taken as an index of number of age-1 fish in the stock; age-2 fish were represented by the juvenile index 2 years before; and so through age 4. Thus, the index value was used as an index of age-4 fish in the fishery in 1976.

There was sufficient evidence to conclude that there was a significant relationship between the PPT trend and commercial landings ($P = 0.006$). A stepwise examination of the regression model resulted in the red snapper landings having the most significant effect ($P = 0.0005$, partial $R^2 = 0.61$), the age-2 variable having the next most significant effects ($P = 0.007$, partial $R^2 = 0.12$), and age-3 variable having the third (and last) significant effect ($P = 0.016$, partial $R^2 = 0.15$). The resulting model is as follows:

$$VSL = 2.593E+06 - 3.075E-01(Red) + 6.825E+06(age\ 2) + 7.419E+06(age\ 3)$$

where *VSL* are vermilion snapper landings in a given year; *Red* is red snapper landings in the same year; *age 2* is the proportion of positive tows year - 2 ; and *age 3* is the proportion of positive tows in year - 3.

These results are also consistent with the findings that age-2 and age-3 fish dominate the commercial landings. Furthermore, the results support the hypothesis that commercial fishers tend to switch to vermilion snapper from red snapper when red snapper are less available (presumably either due to low abundance and /or regulations). Consequently, a decrease in the red snapper quota is likely to increase the fishing effort (and presumably mortality) on vermilion snapper.

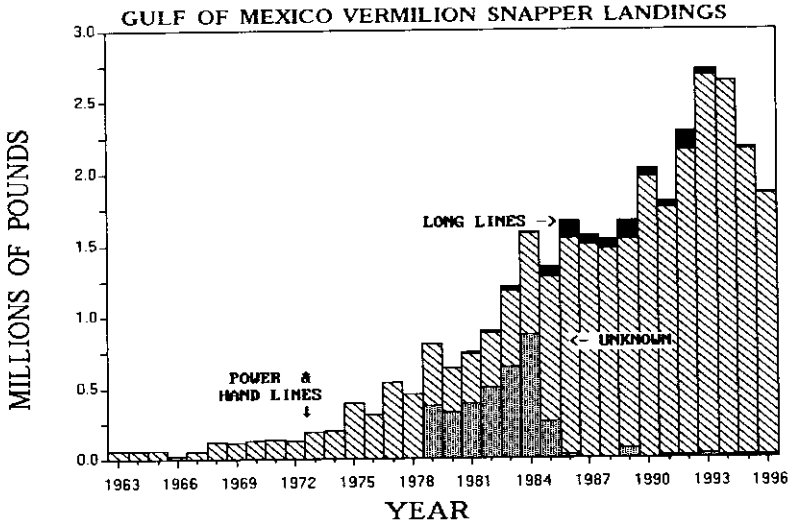

Figure 1. Estimated commercial landings of vermilion snapper from U.S. waters of the Gulf of Mexico by method of capture, 1963-1996.

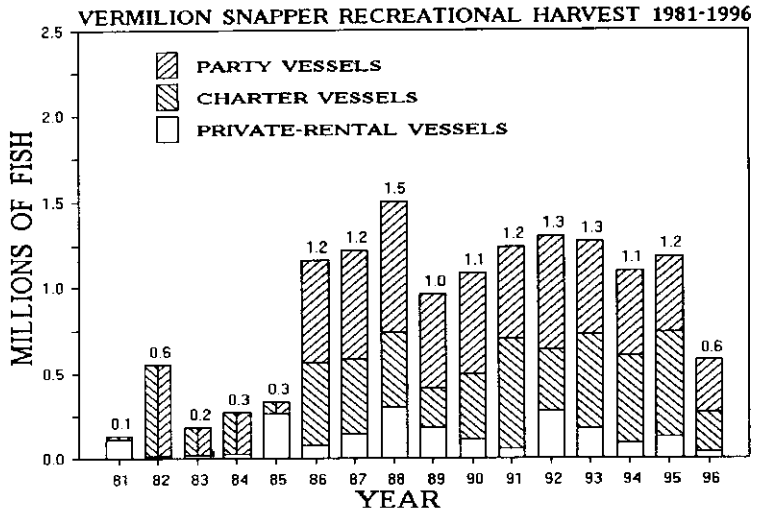

Figure 2. Estimated recreational harvest of vermilion snapper by mode from the U.S. waters of the Gulf of Mexico, 1981-1996.

RED SNAPPER

Commercial Landings

The annual total commercial landings of red snapper include fish captured in both U.S. and Foreign waters. These were separated into the two sources after 1963 using coded grid locations (Figure 3), and the analyses presented in stock assessments are based on the domestic landings only. Commercial domestic landings were relatively stable around 7,000,000 pounds from 1964 until the mid 1970s. The landings subsequently declined to a minimum of around 4,500,000

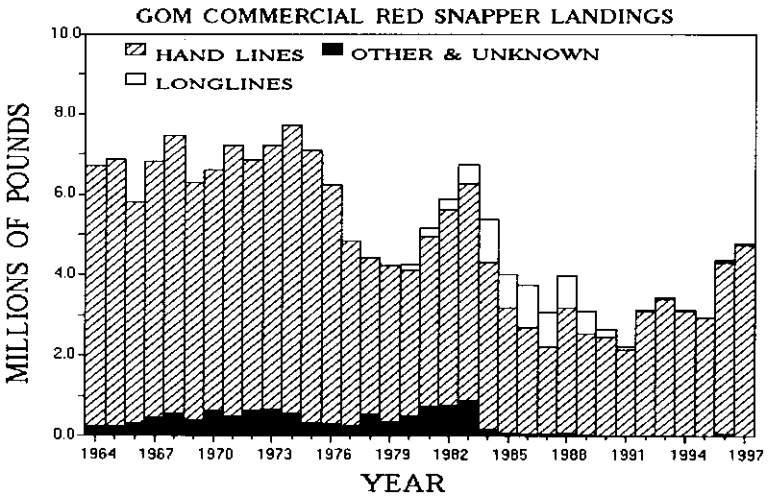

Figure 3. Estimated commercial landings of red snapper from U.S. waters of the Gulf of Mexico by method of capture, 1963-1997.

pounds in 1979, recovered to about 7.165,000 pounds in 1983, and then declined to about 2,230,000 pounds in 1991. In 1990 the Gulf of Mexico Fisheries Management Council set the commercial quota was set at 3,100,000 pounds. In 1991 the Council decreased the commercial quota to 2,040,000 million pounds. In 1992 Council increased the commercial quota to approximately 3,060,000 million pounds. In 1996 the Council increased the commercial quota again to 4,650,000 pounds.

Recreational

Overall, the catch by charter, headboat, and private mode fishermen each contribute equally to the recreational catch for years where the modes can be separated (Figure 4). The overwhelming majority of the catch is from the EEZ, but a substantial portion of the Florida harvest has been reported to be caught in the Florida Territorial Sea each year since the MRFSS survey began in 1979. In the most recent years the total commercial harvest has been near the commercial allocation but the recreational harvest has been substantially larger than it's allocation.

The MRFSS also estimates the number of fish that are caught and released. The states and modes covered by this survey have varied over the years but the available data suggest very few fish were being released in the early years of the survey, but with the onset of effective minimum sizes the release rates increased substantially. Over half of the red snapper estimated caught in 1996 and 1997 were released, presumably because of minimum size.

Shrimp Trawl Discards

Although the discard mortality associated with shrimp trawls is not a part of the harvest, it is a part of the overall fishing mortality. The possible role of this source of mortality as an agent leading to declines in red snapper abundance was raised by Moe (1963) and Bradley and Bryan (1975). Both studies noted that red snapper fishermen believed shrimp bycatch of juvenile snapper lead to declines in red snapper abundance.

The age composition of the bycatch by month was estimated from the length frequencies in the resource survey and bycatch characterization trawl samples. The resulting estimates indicate that young of the year begin to recruit to the bycatch in June and July, and become the dominant part of the bycatch by September. Age-1 red snapper constitute an important part of the bycatch each month.

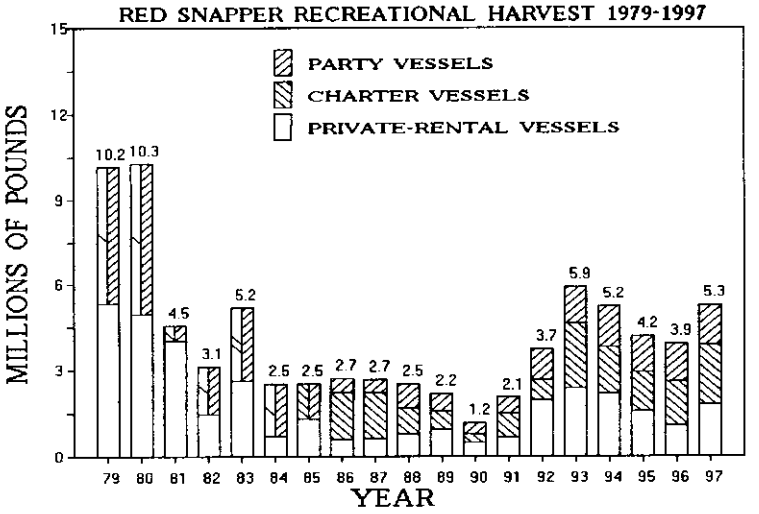

Figure 4. Estimated recreational harvest of red snapper by mode from the U.S. waters of the Gulf of Mexico, 1981-1997.

Trends in Recruitment

Functional regression of the resulting unweighted catch per tow-hour for the age-1 component of the Fall Survey on the summer catch rates for comparable years was found to be significant with a near zero intercept in Goodyear (1995). Therefore, the fall age-1 values were converted to their summer equivalents by dividing by the mean ratio of the 1985-1994, age-1 catch per hour for the Fall Groundfish Survey to the 1985-1994 catch per hour in the summer SEAMAP samples (0.474). This procedure provided estimates of the abundance of age-1 red snapper back to 1972 (year class strengths back to 1971) in units equivalent to the summer SEAMAP survey. A GLM procedure using the "delta" method (Lo et al. 1992) was also applied to this data. First, a model was built only around tows with positive catches of red snapper to arrive at a (balanced design) estimate of the standardized mean catch per positive tow for each year. A

second model was then built considering the presence/absence or red snapper within each cell (year, grid/depth) to model the probability of successful catch of red snapper. The final index was then calculated by multiplying the GLM index of CPUE from the first model by the GLM index of percent-positive-tows from the second model. Significant effects were found for area (statistical grid) and depth. Future effort may directed at examining more closely the distribution of the presence/absence model and perhaps assuming a binomial distribution to logit of complimentary log-log transformed data rather than the approach used by Lo et al. (1992) (log transform of proportion positive + 1).

GAG GROUPER

Commercial Harvest

Because grouper landings were not separated by species prior to 1986 we were unable to track gag separately before that time. In the 11 years that species were separated, gag accounted for an average of 19 percent (ranging from 15 to 23 percent) of the total classified grouper landings, however, this proportion may be increasing. Moe (1969) noted that red grouper composed about 60 to 75 percent of the total grouper catch. Although he did not specify the period for which this estimate applied, it was presumed that he was referring to the period in the early to mid 1960s when his data were collected. These data indicate that the red grouper proportion of the total grouper harvest has been relatively constant, at least since the 1960s. Based on the assumption that gag have been caught in relatively the same proportion as well, I estimated the gag catches for each year prior to 1986 as the product of the total annual unclassified grouper landings and the mean proportion of gag in the 1986-1990 landings (Figure 5). Based on monthly observations, there seems to be some concentration of catch during the months during which spawning aggregations are formed (approximately December to April). Neither an increasing nor a decreasing trend across years is apparent when the landings are examined by month.

Based on observations of annual gag harvest, there is neither an obvious increasing nor decreasing trend in landings fr the period 1986 to 1996, although historical data suggest gag landings could have been larger in the 1960s to 1970s.

The bulk of the 1986-1996 commercial catch of gag was from the eastern Gulf of Mexico to the west and north of Tampa - St. Petersburg, Florida. No apparent trend exists in the spatial distribution of the commercial landings across years during the 1986-96 period.

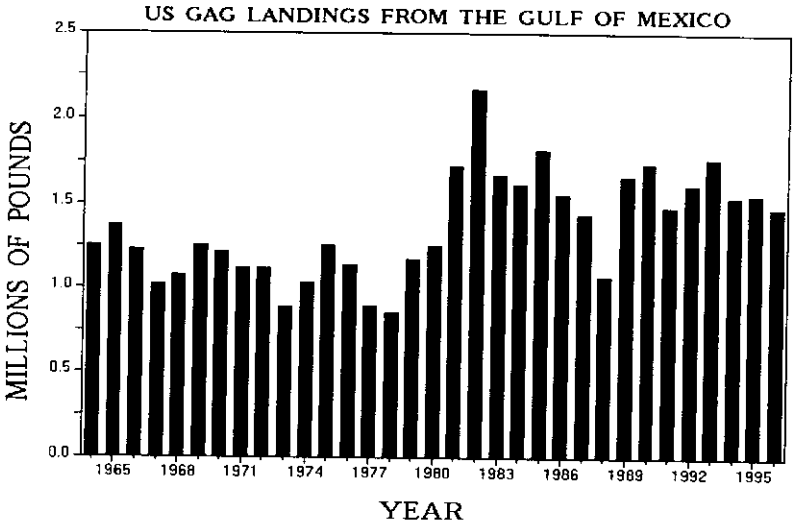

Figure 5. Estimated commercial landings of gag from U.S. waters of the Gulf of Mexico, 1964-1996. Years previous to 1986 are estimated as the product of the total annual unclassified grouper and the mean proportion of gag in 1986-1996.

Recreational harvest estimates

Estimates of recreational harvest have remained relatively constant since the 20 inch minimum size and 5 fish aggregate grouper bag limit was instated in 1990 (Figure 6). As the previous assessment found, more of the recreational catch comes from the EEZ than does state territorial seas.

The distribution of the recreational catch between private vessels and party-charter vessels is very similar. Little if any change in either the distribution or the absolute estimated harvest is evident from 1990 to 1996.

The average percent of gag that were released from private and shore mode anglers increased from a 1981-1989 mean of 36 percent to a 1990-1996 mean of 78 percent. A peak occurred in 1994 with 86.5 percent of gag being released. This peak corresponds well with the recruitment of the relatively strong 1993 year class into the recreational fishery, although fish of this cohort had yet too reach minimum legal size for landing in 1994. The mean size of this cohort, according to estimates of size-at-age, should have been very close to the 20 inch minimum legal size. These releases could have a major impact on the mortality of the gag population. For instance, 1994 there were an estimated 1612

thousand gag released. At an assumed 20 percent release mortality, this would have resulted in approximately 3.22 thousand fish being killed from release mortality while the same year only 2.52 thousand fish were actually kept by recreational fishers.

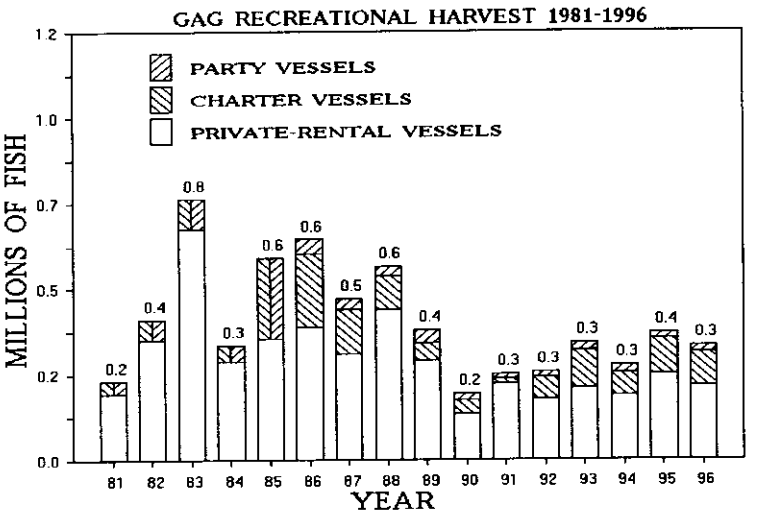

Figure 6. Estimated recreational harvest of gag by mode (excluding shore mode) from the U.S. waters of the Gulf of Mexico, 1981-1997.

PRESENT CONDITION OF THE STOCKS

Currently, fish stocks in the Gulf of Mexico are considered overfished when the spawning potential ratio (SPR) is estimated to be below 20 percent. Based on the latest stock assessment (Schirripa 1998a), the SPR for vermilion snapper is estimated to be in the rang of 21% to 27%, or 26% to 32%, depending upon how much emphasis is on the recruitment index discussed above. In 1997 a 10 inch minimum size regulation was enacted for both the recreational and commercial fisheries. Given that this new regulation has not had time to demonstrate any effectiveness, plus that fact that estimates of SPR were above 20%, no further management action was taken on vermilion snapper in 1998.

Vermilion snapper appear to be a preferred alternative species. When the commercial red snapper quota is met and the fishery closes, landings of vermilion snapper increase markedly. This is evidenced also by the significant negative relation between vermilion snapper and red snapper landings discussed above. Minimum size regulations and bag limits are designed to remove effort

from the regulated species. In actuality, however, that effort is merely shifted to the next most desirable species. Given the relatively high abundance and ease of capture or vermilion snapper, it is a likely candidate for displaced fishers of other species. In this respect, the effects of various regulations need to consider the not only the impact to the target species, but the impact of alternative species as well.

Red snapper remains the most controversial fish species managed in the Gulf of Mexico. Estimates of SPR in the most recent assessment (Schirripa 1998b) are less than 1%, well below the definition of overfishing. The most significant source of mortality is from the undirected shrimp fishery in the form of bycatch. In 1998 bycatch reduction devices (BRDs) were introduced in to the shrimp fishery in an effort to curtail some of this mortality. Along with this, the recreational bag limit was reduced from 5 to 4 fish per fisher per day. A stricter adherence to the recreational quota was also initiated in 1998; for the first time the recreational fishery was closed when it was estimated to have reached it's allocation of 4,468,000 pounds.

SPR was originally conceived for female fish within species that do not change sex. The current use of SPR as a definition of overfishing assumes that the population generally maintains a 50:50 ratio of males to females, or a ratio such that fertilization of the eggs is not limited. It is not clear yet how SPR relates to protogynous hermaphrodites such as gag. Given the uncertainty associated with the sensitivity of the reproductive strategy of this species to overfishing and estimates of SPR (Schirripa and Legault 1997) it is generally felt that SPR should be maintained well above the 20% minimum adopted by the Gulf of Mexico Fisheries Management Council in its definition of overfishing.

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